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# ContraVision: Exploring Users' Reactions to Futuristic Technology

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## ABSTRACT

How can we best explore the range of users' reactions when developing future technologies that maybe controversial, such as personal healthcare systems? Our approach – Contravision – uses futuristic videos, or other narrative forms, that convey either negative or positive aspects of the proposed technology for the same scenarios. We conducted a users study to investigate what range of responses the different versions elicited. Our findings show that the use of two systematically comparable representations of the same technology can elicit a wider spectrum of reactions than a single representation can. We discuss why this is so and the value of obtaining breadth in user feedback for potentially controversial technologies.

## Author Keywords

ContraVision, video, narrative representation, personal technology, pervasive healthcare, user studies

## ACM Classification Keywords

D.2.1: Requirements: elicitation methods; J.4 Social and Behavioral Sciences: sociology

## General Terms

Design, experimentation, human factors, theory

## INTRODUCTION

Engaging with users in the exploration of unfamiliar concepts when developing new technologies can be challenging. It is especially difficult to explore the possible variety of users' responses for future systems or applications, of which users have no direct experience and little knowledge. Typically, a representation of the future technology in the form of a scenario, storyboard, video, etc., is used and instantiated through the experience of particular characters in specific situations, with which users can engage intellectually and emotionally and to which they can respond. However, while with existing technology users' responses are informed by direct experience, with

future technology their responses are informed by the way in which this is represented. The narrative and context in which the technology is portrayed may sway the intellectual and emotional responses elicited, potentially biasing how people view its acceptability, usefulness and usability.

Engaging both the senses of hearing and vision, and utilizing a variety of verbal, musical and visual codes, video can be especially powerful in triggering intellectual and emotional responses. Well known early examples from the 80s and 90s are visionary corporate videos that promoted positive research agendas and that have influenced the use of video in HCI research. Apple's Knowledge Navigator [1] and Hewlett Packard's Cooltown [8] both depicted daily life scenarios, in which individuals' lives were portrayed to be significantly enhanced through the use of fictitious technologies. More recently, Microsoft has developed a similar kind of video about the benefits of new technology in healthcare [4]. As well as shaping technology development intended to benefit individuals and society, these videos have led to much discussion, within the HCI and UbiComp communities, about their negative effects on personal and social life. For example, there is growing concern in society [11] that several new personal technologies that are in the pipeline, such as in pervasive healthcare, will have a profound effect on people's privacy and identity. This suggests that such representations can also act as a powerful means of eliciting user responses regarding the social impact and acceptance of proposed future technologies

If positive representations of future technology scenarios can trigger negative responses, what kind of responses could negative representations trigger? Moreover, could contrasting portrayals elicit a wider spectrum of user reactions, compared to one that promotes a largely positive spin of future technology? If so, would this not be a better way of informing research into the development of future technologies, especially those that are increasingly likely to affect a person's life, such as privacy and identity?

The research reported here is concerned with how different representations of a futuristic scenario can be used to explore the social acceptability and usability of a new

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technology. We describe a new method, ContraVision, for eliciting users' reactions and concerns, which embraces both positive and negative aspects of a future scenario. Using written scenarios, storyboards or video, it aims to uncover the spectrum of often elusive personal, cultural and social concerns that will be relevant to the design and acceptance of personal technologies. The application presented here uses videos – one positive and one negative – of the same scenario. The particular technology envisioned was for a fictitious wearable diet monitoring system, embedded in a pair of ordinary glasses worn by the person, and a chip under the skin. The system 'works' by capturing images of food looked at by the user, determining its calorie level and relaying this to the user's cell phone, and allowing their doctor to access it. The two videos explore how the wearer and other characters behave and react in different settings. The videos were shown to a number of focus groups, individually and collectively. A user study was conducted that investigated the range of reactions elicited by the two videos. We were interested in the kind of responses that could be elicited by the negative representation in comparison with the kind of responses that could be elicited by the positive representation. The findings showed differences in the spectrum of reactions and concerns across the negative and positive videos. We discuss why this is so and the pros and cons of obtaining breadth in user feedback for these types of futuristic technologies.

## BACKGROUND

Recent innovative methods developed in HCI to elicit in-depth user responses to inform the design of new technologies include cultural probes [10], memory phrases [16] and various theatre techniques, such as role playing [19]. *Cultural probes* [10] are a kind of diary study which allow the researcher to enter users' private places without intruding on them, where users are asked to take home a variety of recording devices so that they can record themselves in different domestic situations. The introduction of *memory phrases* [16] in experience sampling studies is a way of eliciting detailed accounts of previous experiences, where users associate any phrase to each sampled episode that works as a mnemonic trigger equivalent to Proust's *madeleine*. Role-playing brings participants into the moment enabling vivid and focused exploration of situations that can generate a range of ideas [19]. Such indirect methods for eliciting peoples' responses allow for appropriate distance from the users' experience, in order not to intrude their privacy and thus altering their spontaneous behavior. At the same time, these methods employ a means of elicitation that can shorten that distance, enabling the collection of data to be similar to that produced by direct observation.

Video has also been used extensively to elicit in-depth responses from users, documenting and reflecting on the design process with various stakeholders [9, 15, 18, 20] and representing scenarios during the process of requirement

elicitation [7, 13-14]. Video scenarios have also started to be used to probe users' intellectual and emotional reactions in response to an experience that they have not lived themselves, but can identify with through fictional characters. One area where this is has much potential is pervasive healthcare scenarios. There has been considerable interest in the development of a variety of technologies for dieting support, ranging from sophisticated personal diet planners and calculators for the mobile phone [3] to photographic food calorie counters [22]. When considering the design of future personal technologies in this domain it is necessary to identify the various factors that may determine their effectiveness, usability, and above all their acceptability [13].

There are potentially infinite ways of representing a subject in a video: a particular video provides one of the many possible representations of that subject. A key question is what representation of a technology to use to elicit appropriate user responses to that technology. Should it highlight all the benefits of the technology? Should it inform about possible problems?

A popular fictional theme in cinema (and other media) is that of *alternative realities* [5]. Most commonly explored in the genres of science fiction and fantasy, it has also informed some comedies, dramas and thrillers, of which Kieslowski's *Przypadek* (*Blind Chance*, 1981), Alain Resnais' *Smoking/No Smoking* (1993), Tykwer's *Lola Rent* (*Run Lola Run*, 1998) and Howitt's *Sliding Doors* (1998) are examples. In these films two (or more) parallel stories, featuring the same characters and the same situations, unfold within the same movie (or in dual movies). The differences between stories follow from different choices made or actions taken by the characters at given points and from the consequent shifts in their circumstances, leading the different stories onto progressively diverging paths. Each of these paths explores different ways in which a character deals with a situation and where that leads.

## METHODOLOGY

The ContraVision method was informed by the dual perspective to film-making. We developed two short films of the same topic that had similar and opposite characteristics that could be compared and contrasted. The videos are comparable in that they treat the same subject, use the same cinematic style, and are made of the same number of scenes representing the same situations with the same characters in the same locations. The videos are contrasting in that their main character has different attitudes and behaviors in relation to the technology and its adoption; the other characters also respond differently to the technology; the single respective scenes have different developments and the two stories have different outcomes.

We used a professional production crew and actors. We worked closely with the producer during the script development, the shooting and the finalization of the

editing. In particular, the scripting and editing went through several iterations and test readings/viewings, to ensure that:

- the two videos were constructed symmetrically enough to be comparable but not to prevent the exploration of aspects specific to each version of the scenario;
- the videos were long enough to allow viewers to immerse themselves in the represented scenario but not to overload them;
- the technology was represented in enough detail to appear realistic but not to lead viewers to focus on its technicalities.

The videos depicted a wearable device designed to assist with people's healthcare and well being. It makes use of tracking devices and sensors to record bodily functions such as heart rate, skin conductivity, blood glucose. The system has much potential to improve the well being of people's lives but at the same time raises contentious issues pertaining to privacy, security and acceptance. While it is designed to make losing weight easier through providing immediate feedback it may also make people feel uncomfortable and awkward, because weight loss is such a sensitive subject. The ContraVision approach is designed to uncover these different facets.

### The Scenario

A fictional dieting support system called DietMon is the focus of the videos. The scenario used depicts Peter, a businessman in his early forties, who is overweight and would like to slim down. He claims he has been keeping a food diary, which shows that he does not eat that much. He also claims to be doing as much exercise as he can fit in with his busy life. However, nothing seems to be able to stop him gaining weight. So, the doctor invites him to try DietMon, a new technology that will assist him in his endeavor to slim down. He will have to wear glasses (fitted with clear lenses for those who don't normally wear them) that are enhanced with invisible cameras hidden in the frames; the cameras take a picture of every food that Peter looks at for more than three seconds and sends it to a database where the system cross-references it in order to identify the approximate number of calories contained in that food. The system will then send a text message to Peter's mobile phone to let him know. If Peter looks at a menu, the system identifies and sends him back the calorific value of each item in the menu. Peter will also have to have a tiny microchip implanted in his wrist, which will record the physiological changes taking place in his body as he eats (for instance, sugar or alcohol levels in the blood). The system sends the data recorded to his doctor, so that she can check whether he is keeping on track, and back to him, to keep him informed on how he is doing. As Peter approaches his daily calorific allowance, the system sends him an alert to let him know that he should stop eating. If he takes the glasses off or forgets to put them on, the microchip still keeps track of his food intake.

To help viewers relate with the futuristic technology, we decided that DietMon should utilize three devices that are familiar to most people, even though in the video they perform unusual functions: a lot of people wear glasses, but these don't have cameras hidden in the frames; texting has become just as common as phoning, but mobile phones don't yet give us feedback about the food that we have eaten or are about to eat; microchips are already being implanted in people's limbs, but they are not yet able to record physiological information. Also, these devices have complementary characteristics. The messages and alerts received on the mobile phone can be seen or heard by others, but the user can exert different levels of control - by keeping the phone hidden from others, lying about the nature of the messages and alerts, or setting the phone to silent mode - without impairing the system's functionality. The glasses record what the user looks at and may constitute a physical imposition if the user does not normally wear them, not to mention the fact that they may attract unwanted questions; however, users have some control over them as they can look away or take them off, although that impairs part of the system's functionality. Finally, the microchip records the user's physiological information and, once it is implanted, the user has no control over it.

The two videos take Peter through a series of situations in which he has to manage his relationship with the technology, with food and other people (aside from the doctor, these are: his wife, his colleagues and a business client). Table 1 provides a brief description of the parallel structure between the six scenes of the videos (the italics highlight differences in the positive and negative representations of each scene's situation).

Although the videos have the same start, the different ways in which Peter manages his relationship with the technology, food and the people around him determine the stories' diverging progression, which ultimately leads to very different outcomes. The videos treat a number of themes explored by the represented scenario, each of which is treated differently in the positive and negative version respectively. These are subtly conveyed in the videos in terms of:

- attitude towards the use of new personal technology;
- attitude towards external support to solve a personal problem;
- influence of the technology on social behavior and relations;
- management of the use of and relation to the technology.

In the positive version of the scenario, Peter reacts to the doctor's proposition with enthusiasm, embracing the technology and the challenge that it poses. He trusts what the doctor says and that the technology can help him. He tells his wife about it with confidence and she reacts with encouragement. He does not let the technology stop him

from joining his colleague's birthday celebrations and sharing her cake, but with the same confidence, he shows off with his colleagues too, managing to impress them (see Fig. 1). He plays with the technology checking out the calorie content of foods he comes across. He manages his relation with the technology proactively and positively, and when he forgets to wear his glasses, he does not panic, instead he works out the unchecked extra calories he has ingested and plans ahead to make sure he compensates at dinner by having lower calorie food. He even manages to use the technology to establish complicity with his client. By the end of the video, he has actually managed to achieve his goal and loose weight.



**Figure 1.** A still from the positive video. Peter gives his colleagues a demonstration of how DietMon works (Chris is wearing Peter's glasses and Peter is waiting for the text with the calorie count to reach his mobile).



**Figure 2.** A still from the negative video. Peter is about to be caught by this wife in the act of stealing a pastry from the fridge.

Peter's behavior is quite different in the negative version of the scenario. He is reluctant to try the new technology to start with. He seems unconvinced by what the doctor says and does not seem to believe that the technology will help. He unwillingly and unconvincingly tells his wife about it and her skeptical reaction just adds to his lack of belief in what he is doing. He is deceptive with his colleagues about the fact that he is on a diet, to the extent of throwing away the slice of cake because it is too big. He suffers at the sight of foodstuffs that the DietMon system rates as having too many calories. This results in him feeling guilty and behaving secretly in front of his wife (see Fig. 2) He

manages his relationship with the technology passively and negatively: he overeats as soon as the phone goes silent; he does not have the foresight to plan ahead so he has to look at the menu at the table, which makes his phone beep; and because Chris is unaware of Peter's use of the technology, he questions Peter's choice of dish, which makes Peter uncomfortable. In the end, harassed by beeps and alerts he cannot justify, he gives up on the technology while eating excessively in front of his client.

At the end of each video, *in-character* interviews are appended. This is a meta-narrative technique, used in TV shows like *The Office* [6], whose function is to allow the viewers to reflect on different aspects of the fiction at a meta-level, through the things that the characters say as themselves during the interviews. In our case, the main characters answer questions about Peter and DietMon, which aim to explore the aspects described above. In the positive version of the scenario, their answers demonstrate a positive and even optimistic attitude towards Peter's endeavor, the technology and what it can do for him. In the negative version of the scenario, they display a negative and even cynical attitude towards both Peter and the technology. Speaking as themselves, they explore a number of issues related to the technology's features.

Positive version	Negative version
Scene 1: at the doctor's	
Peter expresses his concern over his weight. The doctor suggests he uses DietMon and explains how it works. Peter asks questions and seems <i>satisfied</i> with the doctor's answers. He is <i>impressed</i> by what the technology can do and agrees to try it with enthusiasm.	Peter expresses his concern over his weight. The doctor suggests he uses DietMon and explains how it works. Peter asks questions and seems <i>perplexed</i> about the doctor's answers. He appears <i>skeptical</i> about the technology but agrees to try it anyway.
Scene 2: breakfast at home	
Peter starts preparing his breakfast with his new glasses on. His wife notices them and he <i>keenly</i> gives her a demonstration of what they are and how they work, and tells her about the microchip. She seems <i>impressed</i> and leaves the room to get ready for work. Peter opens the fridge to put away the butter and sees a pastry. He looks at it and gets a DietMon message telling him the calorie content of the pastry. He shows that to his wife, who is entering the kitchen and looks at him with a <i>smile</i> .	Peter prepares breakfast with his new glasses on. His wife notices them. While looking at his toast, he gets a text. His wife enquires what that is. He says it's nothing and he does not feel like having toast after all. When she questions why he becomes <i>tense</i> and <i>reluctantly</i> tells her about DietMon. <i>Skeptical</i> , she leaves the room with a sarcastic comment. Peter opens the fridge and sees a pastry. As he gives in and takes a bite, he is caught by his wife, who is entering the kitchen and looks at him with a <i>grin</i> .
Scene 3: birthday party at the office	
Peter is working away at his desk when some colleagues invite him to a small birthday celebration. He tries to refuse but they insist. As he joins them, wearing his glasses, he greets the birthday-lady. His colleague Chris serves him a slice of cake. Peter looks at it and takes out his mobile. He gets a text, checks it and says the slice is too big, and asks Chris to cut it in a half. Chris is intrigued and asks for an explanation, so Peter gives his	Peter is working away at his desk when some colleagues invite him to a small birthday celebration. He tries to refuse but they insist. As he joins them, wearing his glasses, his colleague Chris gives him a slice of cake. He takes the plate and greets the birthday-lady. He gets a text and, <i>pretending</i> it's an important phone call, moves <i>away</i> from the others with the cake. Turned away from them, he <i>throws</i> the cake in a bin and goes back pretending to

colleagues a <i>keen</i> demonstration of how the technology works. His audience is <i>impressed</i> , gathered around him.	have already finished it. Chris comments on how fast he ate. Peter excuses himself, saying he has a deadline to meet, and leaves.
<b>Scene 4: outside the bakery</b>	
Peter is passing by the window of a bakery, with his glasses on, and stops to look at the different foods. He takes out his phone and, looking at each tray in turn, waits for the text with the calorie count. Each time he <i>giggles</i> . Once he has gone through the trays, he walks off with an <i>amused expression</i> on his face.	Peter is passing by the window of a bakery, with his glasses on, and stops to look at the different foods. As he looking at each tray in turn, he gets a beep from his mobile in his pockets. After many beeps, as he is finished looking at all the trays, he walks off with a <i>pained expression</i> on his face.
<b>Scene 5: a drink at the bar</b>	
Peter is having a glass of water and nibbling at a bowl of Bombay mix. This time he has forgotten to wear his glasses. As Chris enters the bar he gestures to remind Peter about the glasses. Peter puts them on and tries to assess the calories he has been eating by picking up and looking at a spoonful of the mix. He then picks up the menu and, <i>in preparation</i> for the imminent dinner, checks the calorie content of each dish.	Peter orders a glass of water, his glasses on. He looks at a bowl of Bombay mix, expecting a text, but none arrives. He checks his phone: nothing happens. He starts nibbling at the mix. Chris enters the bar and asks whether the mix is good. Peter confirms and keeps eating. Suddenly he gets a text: an apology for the temporary interruption of service; then more texts with the calorie count of the mix he has been eating. He is <i>disappointed</i> .
<b>Scene 6: business dinner at the restaurant</b>	
Peter is sitting at the table with Chris and a client. While the others look at the menu, he says he has already made his choice and is going to try a new dish: Tandoori fish. As they are all eating and conversing, a phone alarm goes off. Peter thinks it is his phone and checks it. However, it is not his phone, it is the phone of the client. She goes to switch it off and guesses that Peter must be using DietMon too. She looks at Peter and shows him the screen of her phone, displaying a warning that she is about to reach her daily calorie allowance. They <i>smile</i> at each other. She gestures to ask if it works and Peter pulls the collar of his shirt to show he has <i>lost weight</i> . The client <i>smiles</i> and says out-loud that she has had enough to eat.	Peter is sitting at the table with Chris and a client. As they are all looking at the menu, Peter's phone beeps, he checks the message and says he is going for Tandoori fish. Chris comments that is an unusual choice for Peter, since his favorite dish is chicken Tikka Masala. Peter uncomfortably replies that he wants to try something new. As they are all eating Peter gets an alert: a warning that he is about to reach her daily calorie allowance. He <i>embarrassingly apologizes</i> and says it's an alarm to remind him of something. He keeps eating. Shortly he gets another alert and apologizes again saying that there must be something wrong with the phone. He also takes his glasses off saying that they are new and uncomfortable. He keeps eating.

**Table 1. Scenes in the positive and negative versions of the scenario (the italics highlight differences in the positive and negative representations of each scene's situation)**

### User study

A qualitative study was conducted to elicit user's reactions and concerns. Four groups of 4 participants (16 in total) of mixed backgrounds, gender and age ranging between late twenties and late seventies took part. The groups had a level of cohesiveness in that their members knew each other beforehand and had opportunities to interact outside of the study itself. This choice was made in order to facilitate the interaction between participants during the study. As we wanted them to be able to relax and be spontaneous in their responses, we conducted the study in a domestic environment set-up for the purpose, where they were invited with the members of their group. We ran four

sessions, one for each group: two groups were shown the positive version and two groups were shown the negative version of the scenario. To avoid carry-over effects between viewings, which would have contaminated the findings from the second viewing, we conducted a between-subjects rather than a within-subjects study, with each participant only viewing one version.

The sessions were all structured in the same way: firstly the whole group viewed the fictional video; after that, each participant was interviewed individually in a separate room; once everyone had been interviewed individually, the whole group viewed the *in-character* interviews appended to the video and subsequently took part in a group discussion. The fictional video was approximately 10 minutes long; the individual interviews lasted for about 20 minutes (although some lasted considerably longer); the in-character video interviews were approximately 5 minutes long; and the group discussion lasted for about 30 minutes. Altogether, each session lasted approximately 2 hours.

The group discussions aimed to bring together and encourage the participants to freely elaborate on the responses that they had expressed during the individual interviews and to further reflect on the issues explored in the video after listening to what the characters had to say about Peter and DietMon. The interviews were guided by a series of questions, which aimed at eliciting the participants' responses in relation to the aspects described above (also reflected in the questions answered to by the characters). The questions were the following:

- *What do you think of Peter? What kind of person is he?*
- *What do you think about Peter's experience?*
- *How would you have handled it?*
- *What do you think of the technology he was using?*
- *Would you have any concerns about using it yourself?*
- *What about the information? What is captured? What is transmitted? Who has access to it?*
- *What about others? Would you tell anyone? Would you want others to know?*

The audio-recorded data was transcribed from the individual interviews and group discussions. The responses were then categorized according to the issues that they raised, which are described below. Here, we present the findings from the individual interviews, before participants had the opportunity to discuss their reactions in the focus groups.

### Findings

Both videos elicited participants' responses on a wide range of concerns. However, we also found marked differences in the positions that the positive and negative audiences took with respect to the issues raised. There were differences in the emphasis with which the participants from different audiences took their positions. We also found a number of concerns that emerged from the viewing of one of the videos but not from the other, enabling a wider spectrum of

concerns to be elicited when using a positive and negative video.

A common emerging theme was *safety*; that is the need to feel safe and protected in the use of technology from agents which are not relevant to the individual and potentially dangerous. Within this theme, the videos prompted participants to raise a number of issues: *trust* in and *security* of the technology and the system in general; *physical intrusion* and *possible harm* deriving from the technology; possible uses and potential *misuses* of the information recorded and relayed; and different forms of *privacy breach*.

The videos also raised concerns regarding *identity*; that is the need for participants to see and be themselves within a socio-cultural context in relation to others who are in different ways relevant to the person. These included: *self awareness*, *self perception* and *self representation* to others; levels of *control* and *freedom*, and *pressure* deriving from lack of these; different levels of *openness* and *deception*, and *stress* deriving from the use of deception; *intrusion* in and *influence* on personal and social behavior. Another topic was *value*; that is the participants' value system and assessment of whether the use of technology is appropriate or not for a particular situation. These were issues of *usefulness* and *justification* for use. *Pragmatic* issues were also noted, to do with the quality of the system's functionalities and with its economic sustainability. Below, is a more detailed description of the responses. (We refer to those who saw the positive video as 'positive viewers' and those who saw the negative video as 'negative viewers'; quotes from positive viewers are signaled with the letter P and quotes from the negative viewers are signaled with the letter N).

**Trust in the technology.** Although a positive viewer commented on Peter's open-mindedness, the emphasis was decidedly on his excessively trusting attitude towards a technology that was still new and whose potential negative effects were still unknown. More positive viewers did not think it was normal or natural to accept a new technology at face value without knowing more about it:

"...he is too open...too accepting of new technology...too trusting...it's not normal..."(P6); "...he is almost unnaturally relaxed..."(P7)

On the other hand, most negative viewers expressed the view that the system was trustworthy and that, in any case, Peter should trust it and stick with it:

"...if the microchip has made it to the market, then it must be safe...if they invented the technology, it means that it is needed..."(N13); "...if the doctor says that nobody else sees the information, then I feel safe..."(N13); "...one should trust the opinion of the experts..."(N12)

**Security of the technology.** Most positive and negative viewers demonstrated awareness and concern over potential

security breaches. But negative viewers expressed the highest level of concern:

"...someone clever enough could enter the system and get my information..."(N14); "...every technology can be hacked..."(N4); "...others could use my system against me, if they could get access to my information..."(N3)

**Physical intrusion and potential harm.** Some positive and negative viewers both expressed their dislike at the idea of having a microchip implanted in their body. But especially the negative viewers expressed a concern for possible infections caused by the device or other general adverse health effects:

"...I don't like having a foreign body under my skin...it could affect my health"(N13); "...I would use the microchip if I knew that I don't get an infection..."(N3)

**Uses and misuses of the information.** Only some negative viewers further speculated on possible uses and misuses on the information recorded by and relayed through the technology:

"...others might identify my location through the microchip and use that information to harm me..."(N3); "...I don't want other organizations to have my information for their own use...unless I consented"(N12); "...I would be ok with my information being used, if I knew it was for research..."(N13)

**Different forms of privacy breach.** For most positive and negative viewers having their physiological information recorded and sent somewhere was an issue, but they expressed a greater concern over the fact that the cameras in the glasses could be recording everything they were looking at, as they considered that a greater intrusion into their private life. However, this emerged with more emphasis among the positive viewers:

"...I don't like the fact that all I see could be recorded...it's more intrusive than the microchip..."(P6); "...recording all I see is intrusive of my privacy and liberty..."(P9); "...someone could see that I have a nice TV set at home..."(P6)

"...the combination of the microchip and the cameras is particularly intrusive as one could get my physiological response to what they see..."(P9)

On the other hand, only negative viewers expressed a concern about the fact that the microchip could give away their location, which could be harmful. Also, only the negative viewers observed that:

"...I wouldn't want others to see what I eat if I had a problem with weight..."(N3)

Finally, they observed that they too could be seen by anyone wearing glasses fitted with cameras.

**Self-awareness, perception and presentation.** The positive viewers were divided between those who thought that



Peter's open attitude was a good thing, because he should be relaxed and proud of doing something about his weight using an exciting technology

*"...I would be excited to tell others about the technology..."(P7); "...it shows you do something about your problem...it's good..."(P11)*

and those who thought that he should have not been so upfront, because having to rely on the technology to do something like losing weight shows that one is weak:

*"...I would not expose myself too much...it would make me look bad..."(P5); "...I'm frustrated towards him...he has no will power...if you want to lose weight you just do it..."(P10)*

On the other hand, the negative viewers put much more emphasis on the negative implications of Peter's use of the technology. They thought he was weak for needing the technology and not really serious about losing weight. They also thought that he gave up too easily and that unlike him, they would be able to stick with it.

*"...he is weak because he needs the technology to lose weight..."(N15); "...he is weak because he gives up..."(N1)*

Moreover, they commented that they would not want others to know that they were concerned about issues such as weight. Finally, they expressed a concern about how wearing glasses would affect their image:

*"...I don't normally wear glasses...I don't want people to see me with glasses..."(N3)*

Only one negative viewer thought that using the technology was a sign of commitment to losing weight, so it was not detrimental to one's image if others were to know about it.

Importantly, again, only the negative viewers raised the issue of self-awareness:

*"...Peter's experience is positive, because now he knows more about himself...he can learn..."(N2)*

**Control, freedom and pressure.** Both positive and negative viewers expressed concerns over the fact that the technology takes control away from the individual, creates a dependency and may even lead to the loss of one's faculties due to overreliance on it. In this respect, even though some did not like the cameras in the glasses, they thought that these were preferable to the microchip in that they offered them more control, because they can be taken off:

*"... I would be ok with the glasses, because I could switch them off...I am in control..."(N2)*

However, viewers did not like the fact that they could not take the microchip out of their body or stop it from recording, once it was inserted:

*"...I don't like the microchip because I cannot take it out...I have no freedom after the initial choice to insert it..."(N2)*

They commented that they did not like the idea of being monitored all the time and being told (through the texts) what they can or cannot eat:

*"...I would use the information coming from the texts, but would act freely..."(P8)*

Furthermore, they commented that they did not want to be constantly reminded about food and expressed their preference for a system that was less pressing and would let them be more proactive:

*"...I'd like a system that uses just the mobile phone...I want to be more proactive myself and choose among options..."(P10)*

**Openness, deception, stress and isolation.** Connected to the issue of self-presentation are the issues of openness and deception. As mentioned above, positive viewers were divided on the issue of openness: some said that they would not expose themselves so much and some said that they would share it with excitement. However, not surprisingly, the issue of deception was only explored by negative viewers. In particular, they commented that Peter's determination to hide his use of the technology made his experience very stressful and that he should have been less deceptive and more open in order to lower his level of stress:

*"...I would tell others...it's better to be open to lower the level of stress..."(N2)*

They thought that at least one could afford and indeed should share with family and friends in order to get their support:

*"...it's good to share with others to get their support...friends don't judge you, they are supportive of what you want to do..."(N14); "...with his deception Peter was alienating others..."(N13)*

**Intrusion into personal and social behavior.** Positive viewers observed how Peter was too focused on the use of the technology and how his interaction with it interfered too much with his social interactions. For instance, he lacked spontaneity in social situations:

*"...he was too rigid over the birthday cake...I would treat myself on a special occasion and would eat less later..."(P10)*

Negative viewers, however, were particularly bothered by the way in which the phone alerts and text messages crept in when he was in the company of other people:

*"...I would keep the volume down, so the texts do not do not interrupt and I can focus on other people..."(N4); "I would set it on silent and check when I wanted..."(N13)*

**Usefulness and justification for use.** Both some positive and negative viewers recognized that the technology could



be helpful, but others commented that it was only justified for serious problems such as a critical medical condition: a problem like weight loss was not serious enough:

*"...if you really want to use weight, you just do it..."(N4); "where does it end [doing things through technology]?..."(N13)*

Some positive viewers commented that weight loss could instead be addressed by acquiring good nutritional knowledge and habits, giving an internal, rather than external, solution to an underlying personal management problem:

*"...get into a good habit rather than going for a quick fix..."(P10); "it's just a gadget that has no place in mainstream medicine...too much room to technology undermines good values...it's the beginning of the end of trust...it makes us less human..."(P9)*

Finally, some positive viewers raised the issue of dependency and loss of individual faculties caused by long-term reliance on technology. They also raised the issue of probably unsustainable costs.

**Quality of the system's functionalities.** Few viewers, both positive and negative, made the point that the calorie count of food is not good enough: the system should offer more detailed information:

*"...the system is crude: calories are just one variable...other information about food is needed as well..."(P9)*

In particular, some of the positive viewers made additional comments about other aspects:

*"...one might forget to put the glasses on, if they don't normally wear them..."(P10); "...one might get false alerts even if they accidentally look at food having no intention to eat..."(P11)*

## DISCUSSION

The study elicited a wide spectrum of different and complementary concerns highlighting, in our case study, the complexity of the impact that personal pervasive technology could have on people's lives. As the findings show, there is overlap between the issues raised by the positive and negative videos. For instance, both positive and negative videos triggered concerns about the pressure put by the technology on one's life, by constantly nagging the user and interfering with their social interactions and activities instead of allowing them to be proactive.

However, there are also numerous differences between the two sets of responses. For instance, the positive video elicited reactions of caution triggered by Peter's overly trusting acceptance of the new technology. Consistent with that, the positive video also triggered concerns to do with values and whether the use of technology should be limited to situations in which there is no 'natural' way of addressing a problem. On the other hand, the negative video highlighted concerns about how the very fact of using the technology

may affect one's self and social image. The negative video also elicited reactions to the stress caused by the use of deception for fear of social stigma. Moreover, the negative video raised an issue of self-awareness that did not emerge from the viewing of the positive video.

The responses elicited by the two videos show that if we were to develop a pervasive technology, such as DietMon, a wide range of issues would need to be addressed, covering various aspects of user acceptance and privacy. While user's responses to future technology can certainly be elicited using single videos (or other single narrative representations such as scenarios or storyboards), the results of our study seem to indicate that using different representations of the same technology covers a wider spectrum of issues, revealing more facets of the user's perceptions than a single video (scenario or storyboard) can. This is particularly relevant to the development of personal pervasive technologies, which potentially affects subtle, sensitive and often elusive aspects of people's lives, as our study on a case of personal pervasive technology shows.

The ContraVision method is intended to uncover the range of sensitive and elusive issues, and, as found, can be most effective when considering the design of personal pervasive applications. In particular, having both a positive and a negative representation of the same technology allows for control and breadth:

**Control.** In the case of video, the very act of selecting what aspects to represent, what profilmic reality to shoot, what cinematic codes to use and how, is an act of mediation carried out from a specific (individual or collective) point of view, through which the situation is represented. The same applies to written scenarios and storyboards as determined by their specific mediatic codes and by the act of mediation at the origin of any specific representation. The point of view of the representation will inevitably influence the reactions that the audience has to what is being represented. This can make it difficult to discern to what extent the audience is reacting to the content or rather to the expression, that is, to the technology or to its presentation. Although with future technology this distinction is somewhat artificial, the researcher can distinguish between the set of features characterizing the future technology and the way in which these features are to be portrayed to oppose each other. This facilitates the production of comparable representations and makes it easier for the researcher to control whether the reactions triggered and the issues raised by the videos.

**Breadth.** Producing two systematically and comparably different representations of the same technology allows for the exploration of a broader spectrum of issues than just one representation would allow. In our case, some of the issues that we explored in the two videos emerged from alternative and mutually exclusive representations of the same situation, so they could have not been part of one consistent narrative. Also, having two separate narratives

together allowed us to construct mutually exclusive representations in a more dramatic way and in so doing, provoke users' reactions. In some ways, this form of provocation is akin to the intent behind breaching experiments [23], which aim to put participants in an uncomfortable position (by breaching tacit socio-cultural conventions) in order to provoke their reaction and, in so doing, reveal and create awareness of those conventions.

Systematic comparability of the two different representations enables more control and breadth. It can make it easier to attribute the feedback that is specific to each representation to specific elements in it. It can also make it easier to attribute feedback that is common to both representations to the elements common to both. The representations should systematically explore in different ways a given set of aspects, for example, attitude towards new technology and management of its use, level of openness or deception and influence of the technology on social behavior and relation. It is also important to consider selection criteria, such as the level of symmetry between the representations, their length, the level of detail in which the technology is represented.

It could be argued, however, that the reactions provoked by the two representations can be attributed to the features of the technology that is being represented per se rather than to the particular ways in which those features have been represented in the two versions. Indeed, these are not enough, because specific representational choices made in both versions might still skew the viewers' reactions (for instance the particular choice of characters common to both). As there are potentially infinite ways of representing a subject, the only way of charting exactly which reactions can be attributed to the subject and which to its representation would be to produce an infinite number of versions, which would simply not be possible, let alone viable. The same applies to the breadth of issues explored in the representations: more issues can certainly be explored in an infinite number of versions than they can in two, but is that necessary or even useful? We propose that two representations are sufficient to explore the most significant issues and to chart viewers' reactions, provided that they are systematically comparable according to given criteria.

It could also be argued that producing two representations is not cost-effective, especially when using video, which can be very expensive to produce. However, we suggest that precisely where resource-intensive research methods such as video are employed, it is important that the findings are as reliable and effective as possible. The use of extra resources in the ContraVision approach can be justified for futuristic technologies where it is important to understand the range of personal, social and cultural aspects, especially if the technology is to encroach on an individual's privacy. Only focusing on the potential benefits (e.g. improve one's well health and well being) could blind the developers to potential disasters later on, such as resistance to use or encouragement of deceptive behaviors.

Furthermore, while we have used video as our case study, because it is highly accessible, emotive and is a particularly powerful medium to capture the users' imagination, the ContraVision approach can also be applied to the use of written scenarios or storyboards, which are relatively inexpensive.

The ContraVision method is likely to be most effective when the proposed technology is controversial and might encroach on an individual's privacy or identity. Where working prototypes are available, these may be preferable. Likewise, where researchers seek to explore user's responses to technology that is unlikely to raise sensitive issues that could affect adoption (although this may not be predictable), other inexpensive and straightforward methods may be used to elicit users responses. However, we suggest that the ContraVision method is especially valuable when: 1) researchers seek to explore users' responses to technology that does not yet exist in any usable form and that can only be demonstrated to users via a representation of it; 2) researchers have reason to believe that said technology is likely to raise subtle and elusive personal, cultural and social issues that can potentially jeopardize its adoption.

## CONCLUSION

When exploring the use and acceptability of future technology, video scenarios and other narrative representations, such as written scenarios and storyboards, have tended to represent positive visions of the proposed technology. In contrast, the findings of our study indicate that the use of two systematically comparable representations of the same technology, one positive and one negative, can elicit a wider spectrum of issues than a single representation can and reveal more facets of the perception that people may have of the technology. Similar to stereoscopic vision, the use of the ContraVision method can offer two contrasting points of view for the same object, providing a perception of 'depth' that, just like monoscopic vision, a single representation cannot provide. How far apart the two points of view should be is a question for future research to explore.

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